

Not a “living fossil:” the eastern Pacific bivalve *Tellidorella* belongs with Lucinidae, not Cardiniidae

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ABSTRACT

Tellidorella (type species: *T. cristulata*) is a small eastern Pacific bivalve presently classified in the Cardiniidae, a family otherwise known as fossils from the Paleozoic and early Mesozoic. Evidence from shell characters including external sculpture, hinge teeth, and adductor muscle scars suggests a more appropriate placement in the subfamily Myrteinae of Lucinidae. This is the first record of a myrteine in the eastern Pacific.

Additional keywords: Bivalvia, Myrteinae

INTRODUCTION

The marine bivalve genus *Tellidorella* Berry, 1963 includes a single, small (ca. 6 mm) living species, *T. cristulata* Berry, 1963, which ranges from Baja California to Peru on the eastern Pacific at offshore shelf depths. The familial classification of the genus has been problematic. Originally placed in the Crassatellidae by Berry (1963) it was moved to the Cardiniidae by Cox and Chavan (1969) and regarded as a living species of a family that otherwise ranged from the Ordovician to early Jurassic periods (in their words, a ‘living fossil’). In the meantime, from Pliocene beds of Ecuador, Olsson (1964) described a new genus, *Lirotarte*, with *L. paphia* Olsson, 1964 as type species, which he placed in the Astartidae. This species closely resembles *T. cristulata* and the new genus was subsequently synonymized with *Tellidorella* by Cox and Chavan (1969). They provided the first illustration of *T. cristulata* with an outline drawing of the shell interior and photographic images of *Lirotarte paphia*. Since then *Tellidorella* has continued to be classified within the Cardiniidae (Keen, 1971; Dockery, 1982; Bernard, 1983). However, we believe that *Tellidorella* is much better placed in the chemosymbiotic family Lucinidae rather than Cardiniidae, Crassatellidae or Astartidae and we outline our reasons below with new figures and analysis of characters.

SYSTEMATICS

Tellidorella Berry, 1963

Type Species: *Tellidorella cristulata* Berry, 1963:140, by monotypy.

Lirotarte Olsson, 1964: 40. Type species: *L. paphia* Olsson, 1964: 40, pl. 5, figs. 8, 8a–f), Pliocene, Ecuador, Esmeraldas Formation. Length 3.2 mm, height 3 mm.

Description: Shell features as for *T. cristulata* below.

Remarks: Berry (1963) suggested placement of *Tellidorella* in Crassatellidae because of a general similarity with *Crassiuella* species but noting (p. 140) that the hinge “. . . is altogether distinctive if not indeed unique.” A year later, Olsson (1964) placed *Lirotarte* in Astartidae. Cox and Chavan (1969) synonymized the two genera and placed *Tellidorella* in the Cardiniidae, stating (p. N580) “This small shell is a ‘living fossil’ having all morphological characters of the Cardiniidae, among which are the right duplicate, V-shaped posterior laterals, lack of distinct *5b*, a long *AI*, no marginal *AIV* and *PIV*.”

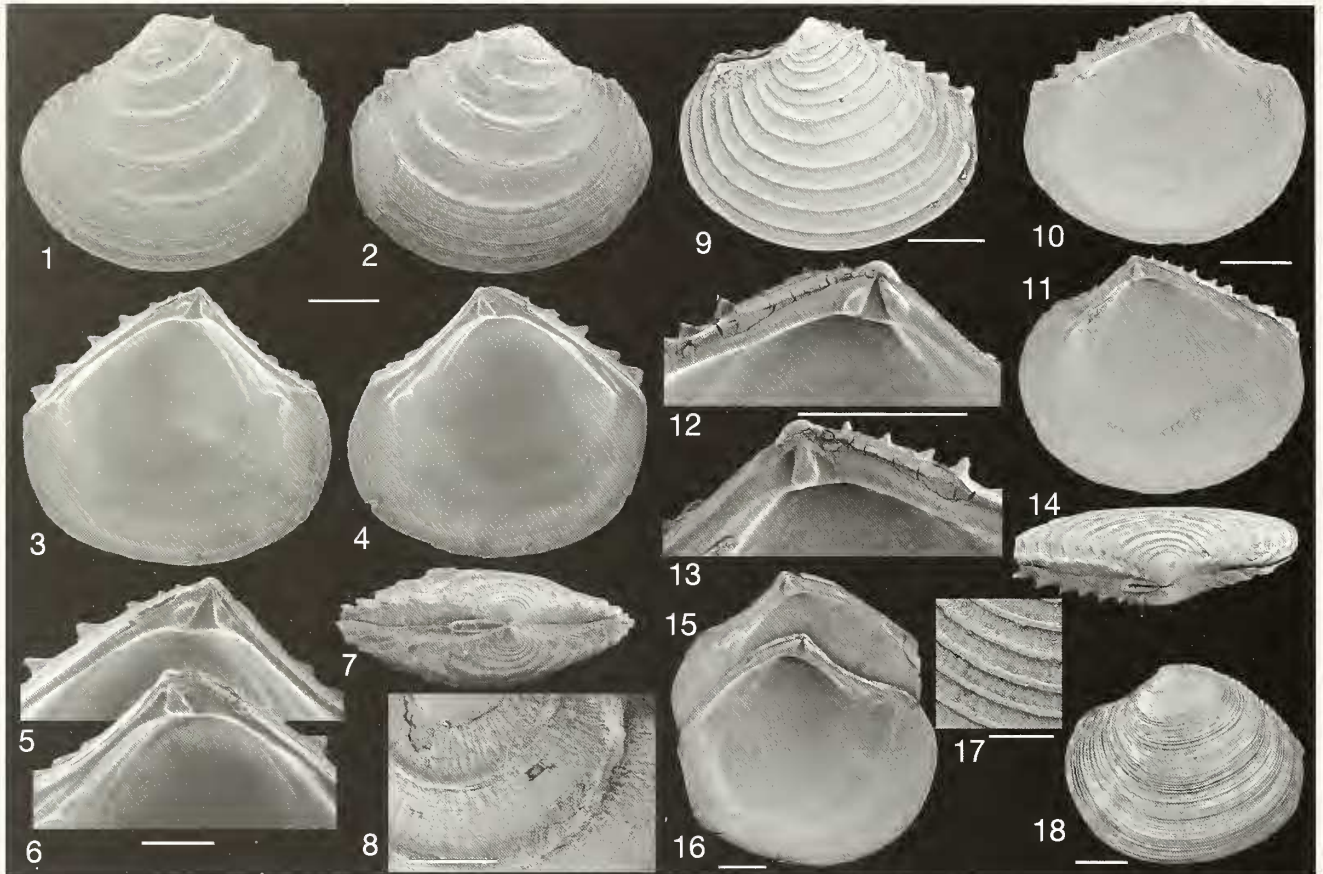
Tellidorella cristulata Berry, 1963
(Figures 1–8, 19)

T. cristulata Berry, 1963: 140

T. cristulata.—Cox and Chavan, 1969: N580, fig. E80A2 (figs. E80A1a–c are *T. paphia* (Olsson, 1964))

T. cristulata.—Keen, 1971: 106 fig. 236 (right valve, interior and exterior of holotype.)

Description: Shell very small (length ca. 6 mm), laterally compressed, slightly asymmetrical with left valve slightly smaller, subtrigonal, ventrally rounded, posteriorly slightly truncate, umbones prominent, sharp, moderately prosogyrate. Sculpture of around 10 widely spaced, projecting commarginal lamellae that become bluntly spinose along the posterodorsal margin. Posterior dorsal area with lower commarginal lamellae in many specimens. Interspaces between commarginal lamellae



Figures 1–8. *Tellidorella cristulata* Berry, 1963, dredged, SE of Punta San Antonio, Sonora, Mexico, 27°53'60" N, 111°4'32" W. Santa Barbara Museum of Natural History, SBMNH 83203. **1–2.** Exterior of left valve (**1**) and right valves (**2**). Scale bar = 1 mm. **3–4.** Interior of left and right valves. **5–6.** Detail of cardinal teeth in left (**5**) and right (**6**) valves. Scale bar = 0.5 mm. **7.** Dorsal view showing lunule, ligament and escutcheon. **8.** Detail of exterior shell sculpture showing radial folds between the commarginal lamellae. Scale bar = 0.5 mm. **Figures 9–18.** *Myrtea spinifera* (Montagu, 1803) (**9–14, 18**) Porcupine Expedition, West of Ireland (Natural History Museum, London, 1885.11.5 817–22) and *Notomyrtea botanica* (**15–17**) New South Wales, Australia, 1.6 km E of Malabar Outlet, Sydney, 66 m (Australian Museum, Sydney, AMS C.360780). **9.** *Myrtea spinifera* juvenile, exterior of left valve. Scale bar = 1 mm. **10–11.** *M. spinifera* interior of left valve (**10**) and right valve (**11**). Scale bar = 1 mm. **12–13.** *M. spinifera*, details of cardinal teeth in left valve (**12**) and right valve (**13**) Scale bar = 1 mm. **14.** *M. spinifera*, dorsal view. **15–16.** *Notomyrtea botanica* interior of right (**15**) and left (**16**) valves. Scale bar = 1 mm. **17.** *N. botanica* detail of external sculpture. Scale bar = 0.5 mm. **18.** *Myrtea spinifera* adult shell. Scale bar = 5mm.

with irregular radial ridges. Lunule lanceolate, elongate, asymmetrical with left side narrower and fitting inside of right valve. Escutcheon long, deep. Ligament external, short. Hinge teeth: right valve with a single triangular cardinal tooth, an elongate anterior lateral tooth and a shorter posterior lateral. Left valve with two small cardinal teeth separated by a triangular socket, anterior and posterior lateral teeth small indentations. Adductor muscle scars unequal, anterior scar larger than posterior. Anterior scar reniform and ventrally detached from the pallial line for about 1/3 of length (Figure 19). Pallial line entire, narrow. Inner shell margin smooth.

Holotype: California Academy of Sciences CAS-IZ 43974.00

Type Locality: Off Puerto Libertad, Sonora, Mexico, 29°51.8' N, 112°46.8' W, 73 m.

Relationships of *Tellidorella*: Although *Tellidorella cristulata* is a little studied species, since Cox and Chavan (1969) its familial position has been firmly entrenched in the Cardiniidae. This family, usually assigned to superfamily Crassatelloidea, is known from fossils ranging from the Ordovician to the Lower Jurassic, with eight included genera. No younger representatives are known except for the Cox and Chavan (1969) assignment of *Tellidorella*. Species of *Cardinia* are common in the early Jurassic (Lias) beds of northern Europe and Palmer (1975) provides good illustrations of a diversity of species. *Cardinia* species usually have robust shells with heavy commarginal ridges and often a V-shaped configuration of the heavy lateral teeth but cardinal teeth are usually weak or absent.

The assignment of *Tellidorella* to Cardiniidae was made on the superficial similarity of hinge teeth with

the V-shaped posterior lateral teeth of cardinids, supposedly also present in *Tellidorella*. But the V-shaped posterior laterals of *Tellidorella* actually consist of a single lateral tooth that becomes dorsally near-confluent with the edge of the escutcheon. The dorsal limb of the V-shaped laterals is actually the inner edge of the escutcheon. Similarly, the so-called duplicate anterior lateral teeth of the right valve are a single, long, true lateral tooth with, dorsally, a groove and then the sharp edge of the lunule. Because the valves of myrteineid lucinids are asymmetrical, the edges of the lunule and escutcheon of the left valve fit into corresponding grooves of the right valve. The figure of *Tellidorella cristulata* in Cox and Chavan (1969, fig. 80A2) is a misleading drawing that shows apparent V-shaped posterior lateral teeth.

An initial inspection of *Tellidorella cristulata* suggested to us that it would be better classified in the family Lucinidae, with particular resemblance to *Myrtea* species, although *T. cristulata* is smaller than most of these. Accordingly, we prepared for SEM (scanning electron microscopy) examination specimens of *Myrtea spinifera* (Montagu, 1803), the type species of *Myrtea* Turton, 1822, and *Notomyrtea botanica* (Hedley, 1918) of similar sizes to *T. cristulata* in order to compare shell characters. These *M. spinifera* and *N. botanica* are juvenile shells, the species reach 25–30 mm and 15 mm in length as adults, much larger than *Tellidorella*.

Shells of juvenile *Myrtea spinifera* and *Notomyrtea botanica* (Figures 9–18) are strikingly similar to *Tellidorella*. Externally, the shell sculpture of *M. spinifera* consists of widely spaced commarginal lamellae that are projected into blunt spines along the posterior dorsal margin. The posterior dorsal area is marked by a zone of lower lamellae. The lunule is long, lanceolate and asymmetrical, the left valve fitting into the right. The escutcheon is long and the ligament short and external. Internally, the hinge teeth are very similar to *Tellidorella*, with a single triangular tooth in the right valve and two small cardinals in the left valve. Lateral teeth are elongate and more prominent in the right valve. The anterior adductor scar has a short length of ventral detachment from the pallial line and the ventral shell margin is smooth. Shell shape and hinge teeth also closely resemble *Notomyrtea botanica* (Figures 15–16) from southern Australia. *Myrtea spinifera* lacks any radial sculpture between the commarginal lamellae but this occurs in other *Myrtea* group lucinids such as *Notomyrtea* (Figure 17) and *Eulopia* Dall, 1901 (see Bretsky, 1976: pl. 34, figs. 11–13; Mikkelsen and Bieler, p. 236).

An important group of shell characters used in the recognition of Lucinidae concern the shape and length of the anterior adductor muscle scar. In most lucinids this is ventrally detached from the pallial line and extends as an inwardly directed lobe. The muscle scar varies both in length and in the angle of and extent of ventral detachment from the pallial line. In genera such as *Miltha* and *Lucinoma* the scar is very long and extensively detached, while in others such as *Myrtea* and

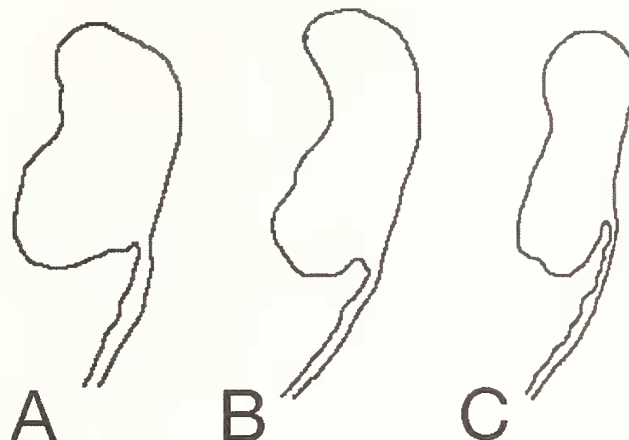


Figure 19. Tracings of anterior adductor muscle scars in left valve. **A.** *Tellidorella cristulata*, **B.** *Myrtea spinifera*, **C.** *Notomyrtea botanica*. Not to scale.

Parvilueina, it is short and only slightly detached from the pallial line. Images of *Tellidorella cristulata* clearly show the anterior adductor scar with a short ventral detachment from the pallial line (Figure 19). This is similar to *Myrtea spinifera* and other 'Myrtea' group lucinids (e.g., Glover and Taylor, 2007: fig. 6; Cosel and Bouchet, 2008: fig. 14). *Tellidorella* shells also have brown staining on the shell located at positions of the anterior inhalant and posterior exhalant tubes indicating the anterior–posterior water flow typical of lucinids. Moreover, a body reconstituted from a dried shell possessed ctenidia with single demibranchs only and a narrow, elongate foot typical of Lucinidae.

In summary, the similarity of shell characters between *T. cristulata* and juvenile *Myrtea spinifera* and *N. botanica* indicate a close relationship. These include the laterally compressed shells, lateral asymmetry, the widely spaced commarginal lamellae projected into postero-dorsal flutes, the long lanceolate lunule, the short external ligament, the similar arrangement of cardinal teeth and the elongate lateral teeth more prominent in the right valve and the anterior adductor muscle with a short length of ventral detachment from the pallial line. *Tellidorella* specimens are always about 6 mm in length and we conclude that it is a small species. Despite the similarity of *Tellidorella* to juveniles of *Myrtea* and *Notomyrtea*, adults of these genera are morphologically distinct (Figure 18).

Although no suitably preserved material was available for molecular analysis we are confident that the shell characters of *Tellidorella cristulata* indicate placement in the Myrteinae subfamily of the Lucinidae. The Myrteinae was first proposed as a subfamily by Chavan (1969) but he included some genera such as *Lucinoma* and *Monitilora* that recent molecular analyses exclude, although species of *Myrtea*, *Notomyrtea* and *Gloverina* form a highly supported clade distinct from all other lucinids (Taylor et al., in press). Little is known of the biology of most myrteines but *Myrtea spinifera* lives in

offshore muds in the north-western Atlantic and, in common with all studied Lucinidae (Taylor and Glover, 2000), possesses symbiotic sulphide-oxidizing bacteria housed in bacteriocytes of the ctenidia (Southward, 1986; Dando et al., 1985). Recent deeper water sampling in the tropical Indo-West Pacific has recovered a diversity of species within the subfamily (Glover and Taylor, 2007; Cosel and Bouchet, 2008).

As well as *Tellidorella paphia* (Olsson, 1964), from the Pliocene of Ecuador, another fossil that can be assigned to the genus is the early Oligocene species *Tellidorella interlacina* Dockery, 1982: pl. 20, figs. 9–10) from the Vieksburg Group, Mississippi, USA, 6.5 mm length. Interestingly, although Dockery classified *Tellidorella* in Cardiniidae he placed the figure amongst Lucinidae species on plate 20. Also, Squires (1990) pointed out that *Corbis uclellani* Hanna, 1927 (length 6 mm) from the middle Eocene of southern California is a likely *Tellidorella* species.

Our conclusion is that *Tellidorella* is not a “living fossil” member of the otherwise Paleozoic–early Mesozoic family Cardiniidae, but should be classified as a small, distinctive eastern Pacific genus in the Myrteinae subfamily of Lucinidae. Although 32 species of Lucinidae are known from the temperate and tropical eastern Pacific (Coan, Valentich-Scott, and Bernard 2000; Coan and Valentich-Scott, in preparation), *Tellidorella* is the only member of the Myrteinae yet recorded.

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